Vachellia x *ruthvenii* (*V. bravoensis* x *V. rigidula*) (Fabaceae: Mimosoideae) in Texas

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ABSTRACT

Principal component (PCA) and principal coordinate analyses (PCO) suggest that *Vachellia bravoensis* and *V. rigidula* rarely hybridize. The putative hybrid shows a relationship to *V. bravoensis* because some leaves have a short rachis with 2 pinna pairs, and the pinnae have 5 to 12 pairs of leaflets. In contrast, the putative hybrid shows a relationship to *V. rigidula* with leaflets mostly longer and wider than in *V. bravoensis*, leaflets with obvious venation, and terminal leaflets of the pinnae being obovate. The hybrid between *V. bravoensis* and *V. rigidula* (*Vachellia* x *ruthveniii*) is described. Published on-line www.phytologia.org *Phytologia 97(2): 170-174 (July 1, 2015).* ISSN 030319430.

KEY WORDS: *Vachellia* x *ruthvenii, V. bravoensis* x *V. rigidula,* Fabaceae, hybrid.

The genus *Vachellia* Wight & Arn., which includes the species of *Acacia* s.l. with paired stipular spines and flowers that lack a floral disc, is represented by 60 species in the New World tropical and subtropical areas (Seigler and Ebinger 2005). Hybrids between a few New Word *Vachellia* species are occasionally encountered. These hybrids mostly involve species morphologically similar and probably related to *Vachellia macracantha* (Humb. & Bonpl. ex Willd.) Seigler & Ebinger that includes the ant-acacias and a few related taxa (Maslin and Stirton 1997, Ebinger and Seigler 1992, Seigler and Ebinger 1995). Hybrids between ant-acacia species and between ant-acacias and non-ant-acacias have been discussed by Janzen (1974), Ebinger and Seigler (1992), and Seigler and Ebinger (1995). Rarely do members of other species groups of *Vachellia* hybridize.

In August of 2001, while on a trip to the Chaparral Wildlife Management Area (CWMA) near Artesia Well, Dimmit and LaSalle Counties, Texas, an unusual specimen of *Vachellia* was pointed-out to John Ebinger and myself by Donald "Chip" Ruthven. Ruthven (presently at Matador Wildlife Management Area, Paducah, Texas) showed us this plant while we were studying the flora of the CWMA. The plant was 3 m tall with a crown nearly 4 m across. At that time the plant was dying, only a few mature, yellowing leaves were present on one of the branches, along with a well-developed basal sprout 20 cm tall with mature and developing leaves. We collected the basal sprout and the mature branches with dying leaves. Two years later the original plant had died and no other specimens of this unusual plant could be found on the CWMA.

The individual examined differed from both parents in many characters, but some characters were intermediate (Table 1). Its growth habit was similar to, but larger than most individuals of *Vachellia bravoensis* found on the CWMA and did not have the few upright gnarled stems common for *V. rigidula,* a species that typically dominates the limestone ridges (calcareous rises) at CWMA. No flowers or fruits were observed and no fruits were found on the ground surrounding the plant. This nearly dead individual was located on flat terrain in thorn-scrub vegetation. The parental species were present in the area along with many other scrubby species, mostly less than 4 m tall (Seigler et al. 2007). The present study was undertaken to examine the morphological differences of this probably hybrid individual and compare those characteristics with the probable parents: *Vachellia bravoensis* (Isely) Seigler & Ebinger and *V.*

rigidula (Benth.) Seigler & Ebinger. These two species are probably not closely related, but are sympatric throughout much of their geographic ranges in southern Texas and adjacent Mexico.

MATERIALS AND METHODS

Analyses were based on herbarium specimens of the putative parents and the hybrid from southern Texas (Appendix I). All specimens were collected by one or both authors and are presently deposited in the herbarium of the University of Illinois (ILL). Initially, the specimens were separated into probable taxonomic groups based on overall morphological similarity. These specimens were scored for seven characters (Appendix II). These data served as the source for principal component (PCA) and principal coordinate analyses (PCoA). Three or more measurements were made for each continuous character of each specimen. These values were then plotted to confirm that gaps in the data existed.

A PCA to identify groupings of the specimens examined was carried out. For this analysis, the data were first standardized and a correlation matrix, eigenvalues, and eigenvectors were calculated using NTSYS-pc verson 2.1 (Rohlf 2000). Eigenvectors were scaled by the square root of λ. The axes were rotated and the resulting loading values graphically represented as both two- and three-dimensional plots.

To carry out the PCoA analysis, Gower's resemblance coefficients were calculated (Legendre and Legendre 1983, Podani 1999, Dickinson 2000). The nature of each character was designated as binary, multistate, or quantitative descriptors and all characters were weighted equally (Dickinson 2000). The data matrix was transformed by the DCENTER algorithm using distances squared and eigenvectors and eigenvalues calculated with NTSYS-pc verson 2.1 (Rohlf 2000). Eigenvectors were scaled by the square root of λ. The resulting loading values were graphically represented as both two- and three-dimensional plots (Figure 1).

RESULTS

The analyses involved 15 specimens of *Vachellia bravoensis*, 13 of V. *rigidula* and one probable hybrid. The PCA based on seven characters (Appendix II), and a PCO based on Gower's similarity coefficients for species scored, proved to be similar (data not shown). In the PCA (Fig. 1), the first three principal components accounted for 47.9, 15.2, and 12.9 % of the variance (76% of the total variance). The two species are well separated on the first principal component (Fig. 1) and the putative hybrid is intermediate (Z01, *Vachellia* x *ruthvenii).*

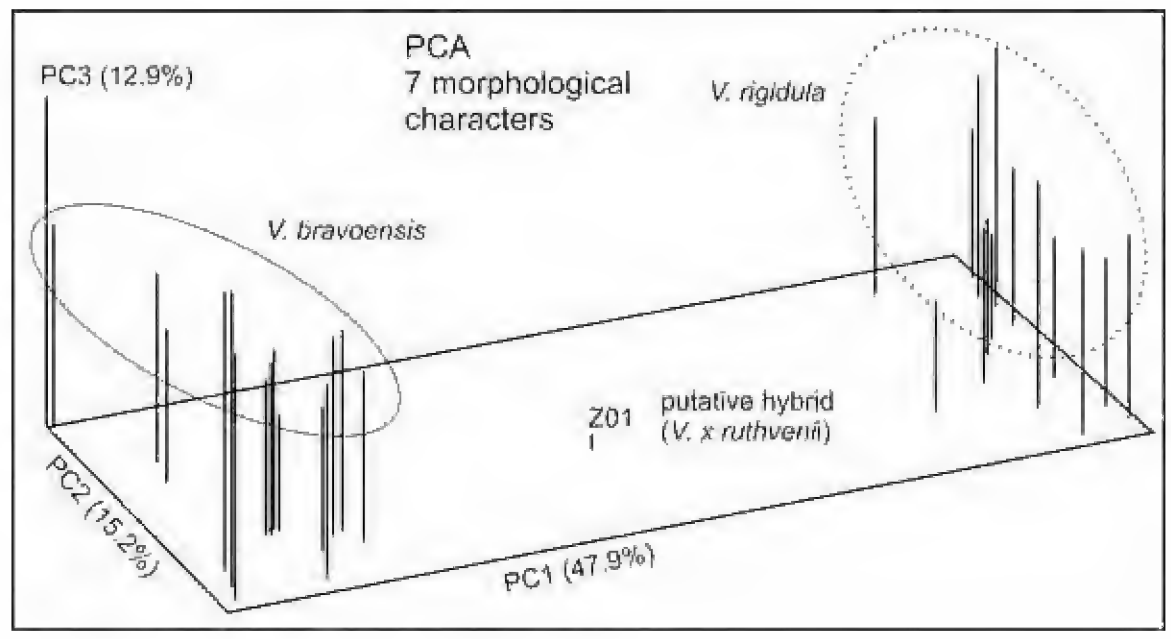

Figure 1. Plot of axis 1 v. 2 v. 3 for the principal components analysis using the seven characteristics (Appendix II) on 15 specimens of *Vachellia bravoensis*, 13 specimens of *V. rigidula*, and one specimen of the probable hybrid (*V.* x *ruthvenii*).

Rachis presence or absence (Rac), leaf venation (LVe), and leaflet length (LLe) (characters 1, 7, and 5) were most important for determining the component score of the first axis; petiole length (PLe), leaflet distance (LDi), and leaflet width (LWi) (characters 2, 4, and 6) were most important for determining the second axis.

DISCUSSION

Both parental species have a relatively narrow geographic range, being restricted to southern Texas and adjacent Mexico. For *Vachellia bravoensis,* we have found specimens from 25 southern Texas counties and the states of Coahuila, Hidalgo, Nuevo León, San Luis Potosí, and Tamaulipas, Mexico. *Vachellia rigidula*, in contrast, has a more extensive range being known from about 30 southern Texas counties and the Mexican states of Coahuila, Jalisco, Michoacán, Nuevo León, Querétaro, San Luis Potosí, Tamaulipas, and Veracruz. We have observed numerous specimens of both species from throughout their ranges, and the specimen described below is the only specimen we have seen that appears to be of hybrid origin. The major differences separating the two parental species and the hybrid are shown in Table 1. The chromosome numbers of both parental species are known to be 2n = 26 (Turner & Fearing 1960). However, it was not possible to obtain this information from the proposed hybrid.

Vachellia* x *ruthvenii Seigler & Ebinger, **nothospecies nov.** (*Vachellia bravoensis* x *V. rigidula).*

TYPE: UNITED STATES. TEXAS: Dimmit Co.: Chaparral Wildlife Management Area, 2 miles NW of the laboratory building, 8 miles W of Artesia Wells, 20 August 2001, *D.S. Seigler, A. Kerber & J.E. Ebinger 15114* (ILL). (Figure 2). (Holotype: ILL, Isotype: ILL).

Shrub or small **tree** to 4 m tall; bark light gray to brown, smooth to shallowly furrowed; twigs dark purplish brown, slightly flexuous, lightly puberulent; short shoots commonly present above the stipular spines, 1-4 mm long, covered with acuminate stipules and old leaf bases; prickles absent. **Leaves** alternate, also clustered on the short shoots, 2-15 mm long; stipular spines light gray, symmetrical, terete, straight, woody, 0.2-3.0 x 0.2-1.2 mm near the base, lightly puberulent, persistent; petiole adaxially grooved, 2-7 mm long, lightly puberulent; petiolar gland solitary, located on the upper half of the petiole, sessile, circular to oblong, 0.2-0.7 mm long, apex depressed, glabrous; rachis adaxially grooved, 0-8 mm long, puberulent, glands absent; pinnae 1 to 2 pairs per leaf, 12-19 mm long, 4-7 mm between pinna pairs; paraphyllidia absent; petiolules 1.0-2.6 mm long; leaflets 5 to 12 pairs per pinna, opposite, 1.1-2.7 mm between leaflets, oblong (terminal pinna leaflets usually obovate), 3.5-7.5 x 1.2-2.2 mm, glabrous, lateral veins obvious, 1 to 3 veins from the base, base oblique, margins usually not ciliate, apex broadly acute to obtuse, usually mucronate, midvein subcentral. **Inflorescences, flowers, fruits, and seeds:** Not seen.

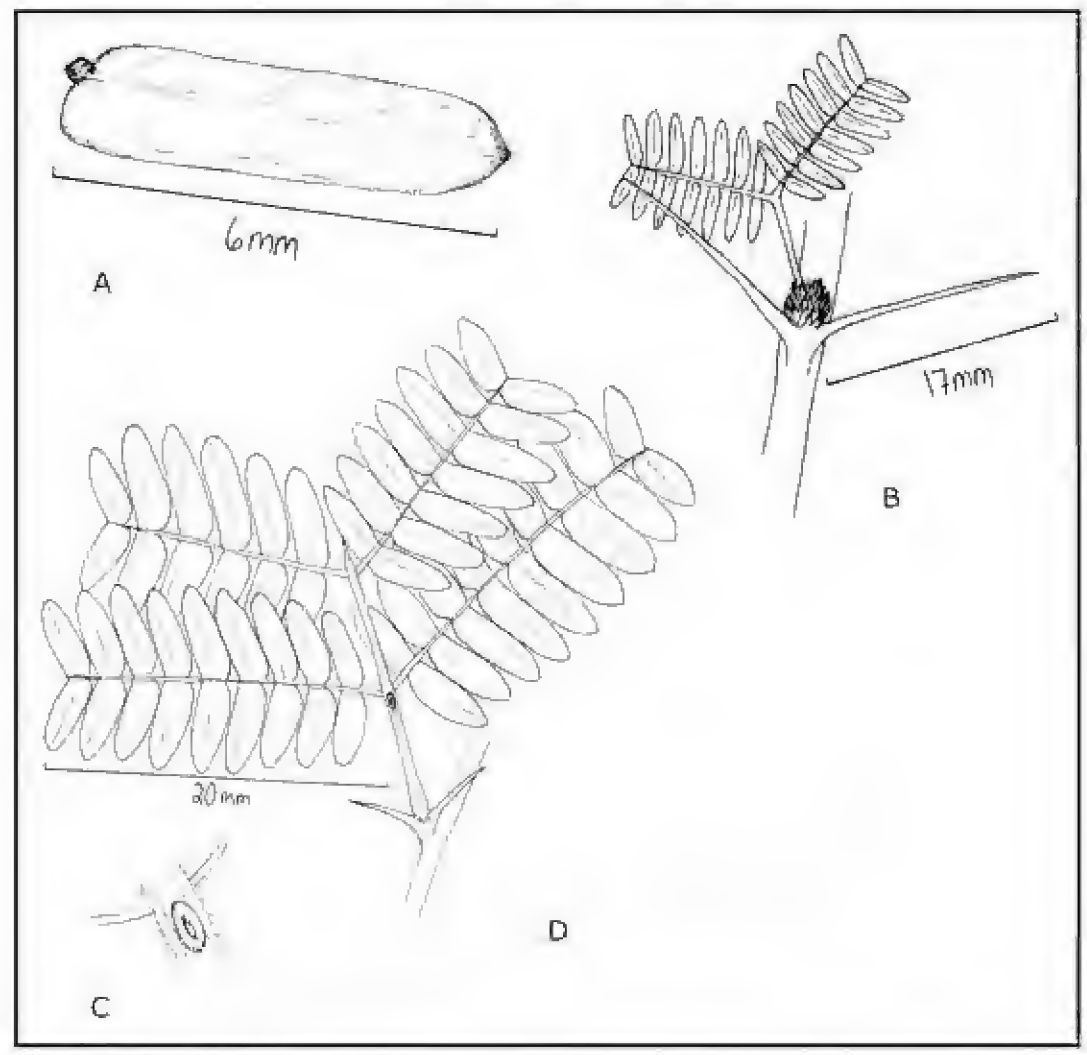

Figure 2. *Vachellia* x *ruthvenii* Seigler & Ebinger. A: Leaflet (abaxial surface); B. Node with stipular spines, short shoot and secondary leaf; C. Petiolar gland; D. Primary leaf with petiolar gland.

ACKNOWLEDGMENTS

The authors thank their colleagues, Donald "Chip" Ruthven, R. Gordon Tucker (EIU) and Lowell Urbatsch (LSU) for helpful comments on the manuscript. We wish to acknowledge the assistance of Alexa Musgrove with the art work.

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Table 1. Characteristics that separate *Vachellia bravoensis*, *V. rigidula* and the hybrid *V. x ruthvenii*.

Characteristic	V. bravoensis	V. x ruthvenii	V. rigidula
rachis	mostly present	some present	absent
pinna pairs/leaf	1-3 (4)	1 to 2	1
petiolule length	0.4-1.0 mm	1-2.6 mm	1-3 mm
leaflet pairs/pinna	10 to 24	5 to 12	(2) 3 to 5
leaflets distance	0.5-1.1 mm	1.1-2.7 mm	1.5-5.0 mm
leaflet length	2.0-4.2 (5.0) mm	3.5-7.5 mm	(4) 6-13 (16) mm
leaflet width	0.6-1.1 mm	1.2-2.2 mm	3-6 (8) mm
leaflet margin	ciliate	not ciliate	not ciliate
leaflet venation	usually not obvious	obvious	obvious
terminal leaflet shape	linear to oblong	obovate	obovate to elliptic

Appendix I. Specimens scored for the principal component (PCA) and principal coordinate (PCoA) analyses.

Vachellia bravoensis: TEXAS: Atascosa Co.: S of Jourdantown, 29 Jun 1986, *D.Seigler & B.Maslin 12670*; road to San Miguel Power Plant, 10 Jul 1998, *D.Seigler & J.Ebinger 14331*. **Bexar Co.:** S-side of San Antonio, 22 May 1976, *D.Seigler, S.Saupe & H.Welt 10054*. **Dimmit Co.:** US 277, 26 miles E of junction of 57 and US 277, 16 Sep 1979, *D.Seigler & D.Young 11401*; Chaparral Wildlife Management Area, 22 May 2001, *D.Seigler & J.Ebinger 14889*, Chaparral Wildlife Management Area, 20 Aug 2001, *D.Seigler, A.Kerber & J.Ebinger 15116*; Chaparral Wildlife Management Area, 19 May 2005, *D.Seigler, J.Miller & B.Maslin 15931*. **Kinney Co.:** route 90, 4 miles W of Brackettville, 27 Jun 2002, *D.Seigler & J.Ebinger 15265*. **LaSalle Co.:** 3 miles W of Artesia Wells, 24 Aug 2001, *D.Seigler, A.Kerber & J.Ebinger 15135A*. **Maverick Co.:** US 277, 29 miles NW of Eagle Pass, 10 Jul 1998, *D.Seigler & J.Ebinger 14363*; 10 miles E of Eagle Pass, 27 Jun 2002, *D.Seigler & J.Ebinger 15268*. **McMullen Co.:** 1 mile N of Texas route 791, 11 May 1991, *D.Seigler, J.Ebinger, H.Clarke & K.Readel 13270;* S of Tilden, 10 Jul 1998, *D.Seigler & J.Ebinger 14336*. **Uvalde Co.:** Harris Ranch near Cline, route 90, 24 Jun 2002, *D.Seigler & J.Ebinger 15218*. **Webb Co.:** 7 miles N of junction of US 83 and I-35, on US 83, 21 May 1983, *D.Seigler, J.Kramer & E.Carreira 11958*.

Vachellia x ruthvenii: TEXAS: Dimmit Co.: Chaparral Wildlife Management Area, 2 miles NW of the laboratory, 28° 00' 34" N, 99° 26' 43" W, 20 Aug 2001, *D.Seigler, A.Kerber & J.Ebinger 15114*.

Vachellia rigidula: TEXAS: Atascosa Co.: 9 miles S of Jourdantown, route 1, 15 Sep 1979, *D.Seigler & D.Young 11381*; road to San Miguel Power plant, 10 Jul 1998, *D.Seigler & J.Ebinger 14323*. **Dimmit Co.:** Chaparral Wildlife Management Area, 19 May 2005, *D.Seigler, J.Miller & B.Maslin 15930*. **Frio Co.:** I-39, 1 mile SW of Bigfoot, 26 May 2001, *D.Seigler & J.Ebinger 15058*. **Jim Wells Co.:** 9 miles N of Alice, route 281, 6 Jun 1991, *D.Seigler, J.Ebinger, D.Clarke & K.Readel 13764*. **Kinney Co.:** 15 miles NE of Bracketville, route 334, 20 May 1976, *D.Seigler, S.Saupe & H.Welt 9931*. **McMullen Co.:** 3 miles E and 1 mile N of Tilden, 25 May 2001, *D.Seigler & J.Ebinger 15025b*. **San Patricio Co.:** 1 mile N of Sinton, route 77, 10 Jun 1980, *D.Seigler, P.Richardson & S.Thompson 11635*. **Starr Co.:** access road to Falcon Dam, 18 Feb 2004, *D.Seigler, J.Ebinger & L.Phillippe 15894*. **Val Verde Co.:** Langtry, 21 May 1976, *D.Seigler, S.Saupe & H.Welt 9955*; Pecos River Bridge, route 290, 16 Sep 1979, *D.Seigler & D.Young 11416*. **Webb Co.:** 45 miles NE of Laredo, route 59, 22 May 1976, *D.Seigler, S.Saupe & H.Welt 10038*. **Zapata Co.:** Arroyo Dolores, 25 miles N of Zapata, route 83, 18 Feb. 2004, *D.Seigler, J.Ebinger & L.Phillippe 15884*.

APPENDIX II: Characters used for PCA of *Vachellia bravoensis, V. rigidula*, and *V.* x *ruthvenii*.

1. Rachis (Rac) – 1. present, 2. absent;
2. Petiole length (mm) (PLe);
3. Leaflets pairs/pinna (LPi);
4. Leaflet distance (mm) (LDi);
5. Leaflet length (mm) (LLe);
6. Leaflet width (mm) (LWi);
7. Leaflet venation (LVe) – 1. 1ateral veins not obvious, 2 lateral veins obvious.